DuPont Pompton Lakes Works
2000 Cannonball Road
Pompton Lakes, NJ 07442

May 28, 2013

Mr. Anthony Cinque
New Jersey Department of Environmental Protection
Division of Responsible Party Site Remediation
401 East State Street
P.O. Box 028
Trenton, New Jersey 08625-0028

RE: Wanaque River Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey
PI #007411

Dear Mr. Cinque:

Attached please find one hard copy and two CDs of the *Wanaque River Interim Remedial Measure Work Plan*.

DuPont received correspondence from the New Jersey Department of Environmental Protection (NJDEP) dated February 21, 2013 (received February 27, 2013) requesting the submittal of this document. NJDEP transmitted further correspondence to DuPont dated March 7, 2013 (received March 14, 2013) that revised the submittal date to be within 90 days after receipt of NJDEP's letter dated February 21, 2013.

If you have any questions, please contact me at (973) 492-7733.

Sincerely,

David E Epps

David E. Epps, P.G.
Project Director, Pompton Lakes Works
DuPont Corporate Remediation Group

cc: Clifford Ng, USEPA (1 CD)
PLW File

REPORT

Wanaque River
Interim Remedial Measure Work Plan

DuPont Pompton Lakes Works
Pompton Lakes, New Jersey
PI #007411

May 2013

SECTION M. PERSON RESPONSIBLE FOR CONDUCTING THE REMEDIATION INFORMATION AND CERTIFICATION			
Full Legal Name of the Person Responsible for Conducting the Remediation: E.I. du Pont de Nemours and Company			
Representative First Name: Michael		Representative Last Name: Lukas	
Title: Remediation Team Manager			
Phone Number: (302) 999-3567	Ext:	Fax:	
Mailing Address: Chestnut Run Plaza Bldg 715, 4417 Lancaster Pike			
City/Town: Wilmington	State: DE	Zip Code: 19805	
Email Address: michael.j.lukas@usa.dupont.com			

This certification shall be signed by the person responsible for conducting the remediation who is submitting this notification in accordance with Administrative Requirements for the Remediation of Contaminated Sites rule at N.J.A.C. 7:26C-1.5(a).

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, including all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.

Signature: Michael Lukas Date: 5/28/13

Name/Title: Michael J. Lukas, DuPont CRG Remediation Team Manager **No Changes Since Last Submittal** ☐

SECTION N. NON-LSRP SITE REMEDIATION PROFESSIONAL STATEMENT			
First Name: Norma		Last Name: Eichlin	
Phone Number: (973) 492-7725	Ext:	Fax: (973) 492-7749	
Mailing Address: 2000 Cannonball Road			
City/Town: Pompton Lakes	State: NJ	Zip Code: 07442	
Email Address: norma.eichlin@obg.com			
I believe that the information contained herein, and including all attached documents, is true, accurate and complete.			
Signature: Norma L. Eichlin		Date: 5/28/13	
Name/Title: Norma L. Eichlin, Vice President		**No Changes Since Last Submittal** ☐	
Company Name: O'Brien & Gere			

Completed forms should be sent to:

Bureau of Case Assignment & Initial Notice
Site Remediation Program
NJ Department of Environmental Protection
401-05H
PO Box 420
Trenton, NJ 08625-0420

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ACRONYMS

BEERA	NJDEP Bureau of Environmental Evaluation and Risk Assessment
bgs	below ground surface
CBR	critical body residue
cfs	cubic feet per second
Contractor	prospective remediation contractor
COPEC	Constituent of Potential Ecological Concern
CSM	conceptual Site model
DuPont	E.I. du Pont de Nemours and Company
EMA	Eastern Manufacturing Area
ESC	ecological screening criteria
IRM	Interim Remedial Measure
IRMWP	*Interim Remedial Measure Work Plan*
LEL	lowest effects level
MeHg	Methylmercury
mg/kg	milligrams per kilogram
mm	millimeter
NAD-83	New Jersey State Plane Coordinate System 1983
NAVD-88	North American Vertical Datum 1988
NJDEP	New Jersey Department of Environmental Protection
NJ RDCSRS	NJDEP Residential Direct Contact Soil Remediation Standards
NJSWQS	New Jersey Surface Water Quality Standards
NMA	Northern Manufacturing Area
NRWQC	National Recommended Water Quality Criteria
PCBs	polychlorinated biphenyls
PLW	Pompton Lakes Works
RAO	remedial action objective
RFA	NJDEP Stormwater Construction General Permit
RI	remedial investigation
RIR	*Wanaque River Remedial Investigation Report*
SEL	severe effects level
SPT	standard penetration test
SVOCs	semivolatile organic compounds
TCLP	toxicity characteristic leaching procedure
Technical Status Report	*Wanaque River Investigation Technical Status Report*
THg	total mercury
TOC	total organic carbon
TRSR	Technical Requirements for Site Remediation
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds
WMA	Western Manufacturing Area

1.0 INTRODUCTION

1.1 Background

The former E.I. du Pont de Nemours and Company (DuPont) Pompton Lakes Works (PLW) Site (Site) is located at 2000 Cannonball Road in Pompton Lakes, Passaic County, New Jersey (see Figure 1).

Remedial investigation (RI) activities have been ongoing at the Site since 1988. An initial investigation of surface water and sediment in the Wanaque River was conducted in 1990 at the southern portion of the Site and south of the Site. Surface water (unfiltered) and sediment samples were collected and analyzed for metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs). The investigation identified the following:

Surface Water

- Mercury exceeded the freshwater benchmark concentration at one location near the downstream boundary of the Site.
- Acetone, methylene chloride, and bis(2-ethylhexyl)phthalate were the only organic constituents detected and concentrations were below ecological benchmark concentrations.
- No PCBs were detected.

Sediment

- Maximum detected concentrations of copper, lead, and mercury exceeded conservative ecological benchmark concentrations.
- Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were the only organic constituents detected and concentrations were below ecological benchmark concentrations.
- No PCBs were detected.

After the initial investigation, remedial activities (removal and/or stabilization) were completed under the direction of the U.S. Environmental Protection Agency (USEPA) and New Jersey Department of Environmental Protection (NJDEP) to address impacted soils in upland areas of the Site adjacent to the river. Data from the 1990 sampling effort in the Wanaque River was not deemed sufficient to achieve the objectives of an RI and additional sediment sampling was completed within the river to characterize the presence of Site-related compounds and evaluate whether additional remedial measures are necessary.

In July 2010, the *Wanaque River Remedial Investigation Report* (RIR) was submitted to NJDEP and USEPA. The Wanaque River study area investigated during the RI includes three reaches of the river in the vicinity of the Site (see Figure 2):

- Reach 1 – Extends approximately 2.0 miles from the Raymond Dam, which forms the Wanaque Reservoir, to the upstream Site property boundary (this reach considered representative of regional background conditions);

- Reach 2 – Extends approximately 1.5 miles from the upstream Site boundary through the Site to the location of the former dam that formed Lake Inez; and

- Reach 3 – Extends approximately 1.3 miles downstream of the former dam that formed Lake Inez.

The objectives of the RI were to:

- Characterize physical and chemical conditions in the Wanaque River to refine the existing conceptual Site model (CSM);

- Evaluate potential migration pathways for Site-related constituents in sediment and surface water to the Wanaque River and actual or potential receptors; and

- Determine whether further evaluation or action is warranted in the river.

NJDEP provided comments on the RIR in October 2010. Supplemental RI work was conducted in November 2010 to address the comments, and a revised RIR was submitted in July 2011. The RI for the Wanaque River identified the following:

- Given the frequency of exceedances and elevated concentrations relative to NJDEP-recommended sediment quality benchmarks (i.e., lowest effects level [LEL] and severe effects level [SEL]), mercury is the primary sediment constituent of potential ecological concern (COPEC) in the Wanaque River adjacent to and downstream of the Site.

- The primary contaminant transport pathway from former Site operations to the Wanaque River is likely historical migration from the adjacent uplands and floodplain. The current conditions of river banks and floodplain/upland areas adjacent to Reach 2 are stable and vegetated, which limits the mobilization of particulate-bound COPECs to the river.

- Surface-water concentrations of filtered and unfiltered total mercury (THg) and other Site-related metals are below chronic surface water criteria for the protection of aquatic life (i.e., New Jersey Surface Water Quality Standards [NJSWQS], National Recommended Water Quality Criteria [NRWQC]); therefore, no unacceptable risks to aquatic life are identified for surface water exposure.

- Mercury concentrations in sediment in the lower portion of Reach 2 (within a zone of sediment deposition downstream of WR-16 to the former dam) increased in relation to upstream samples within Reach 1 and 2 and then decreased substantially in the spatially limited depositional features downstream of the former dam (Reach 3).

- With the exception of the zone of sediment deposition immediately upstream of the former dam, fine-grained sediment deposits represent a relatively minor component (approximately 5 to 10 percent) of overall habitat availability in Reaches 2 and 3.

As stated above, the RIR identified mercury as the primary sediment COPEC for exposure to ecological receptors. In addition, mercury in sediment was identified as a potential human health exposure due to concentrations exceeding the New Jersey Residential Direct Contact Soil Remediation Standard (NJ RDCSRS). Mercury concentrations above the NJ RDCSRS in fine-grained sediment deposits were reported in samples collected from the river directly north of the former Lake Inez dam to approximately 1,200 feet upstream (see Figure 3). The RIR recommended an interim remedial measure (IRM) be implemented to mitigate potential human health and ecological exposure to mercury in depositional sediments identified north of the former Lake Inez dam.

Supplemental investigations were completed in 2011 and 2012 to provide additional information to address NJDEP Bureau of Environmental Evaluation and Risk Assessment (BEERA) comments and to support the development of an IRM to address potential exposure to mercury in sediments. The overall purpose of the investigations was to provide additional characterization of mercury in the fine-grained sediment deposits and perform detailed substrate mapping to define the extent of fine-grained sediment deposits outside of the IRM area identified in the RIR. Additionally, sediment and pore water samples were collected based on the results of the detailed substrate mapping. The findings of these supplemental investigations were consistent with the findings presented in the revised RIR (URS, 2011) and were documented in the *Wanaque River Investigation Technical Status Report* (Technical Status Report) submitted in October 2012.

NJDEP reviewed and provided comment on the Technical Status Report in a letter dated February 21, 2013. NJDEP's comment letter required the preparation of an *Interim Remedial Measure Work Plan* (IRMWP) as recommended in the RIR. This IRMWP presents the approach to remediate fine-grained sediments within specific areas of the Wanaque River. The IRM will be conducted in accordance NJDEP's *Technical Requirements for Site Remediation (TRSR)* (7:26E-1.10).

1.2 Purpose of Work Plan

The purpose of the IRMWP is to present the following:

- CSM developed through the RI and supplemental investigations conducted for the river;
- Remedial action objectives (RAOs);
- Description of pre-IRM activities to be conducted; and
- IRM approach, monitoring program, and restoration.

The overall objective of the IRM is to remove fine-grained sediments in specified areas within the river bed and shoreline where mercury is present at concentrations greater than the NJ RDCSRS north of the former Lake Inez dam, thereby mitigating the potential human health (direct contact) exposure and reducing ecological exposure to mercury in depositional sediments.

1.3 Work Plan Organization

Brief summaries of the remaining sections are presented below.

- Section 2: *Site Background and Physical Setting* – This section provides an overview of the Site including Site description, current use, and surface water features.

- Section 3: *Conceptual Site Model* – This section presents the CSM developed for the Wanaque River in the vicinity of the Site.

- Section 4: *Wanaque River Sediment IRM* – This section provides a summary of the IRM RAOs, pre-IRM activities, and IRM implementation.

- Section 5: *Permitting and Other Approvals* – This section presents a summary of the permits and approvals required to conduct the IRM.

- Section 6: *Project Schedule* –This section provides the anticipated path forward and project schedule for the IRM implementation.

- Section 7: *References* – This section lists the references cited in the IRMWP.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 Site Description and Location

The 570-acre PLW Site is located in the Boroughs of Pompton Lakes and Wanaque in Passaic County, New Jersey (Figure 1). The Site consists of northeast trending ridges and valleys containing two major drainage areas: the Wanaque River (former Lake Inez) on the west and Acid Brook on the east. New Jersey Interstate 287 (I-287) crosses the northern and western portions of the Site isolating approximately 70 acres. The Site is bordered to the northeast and east by Ramapo State Forest (deciduous forest and some deciduous wooded wetlands); to the south by the town of Pompton Lakes (industrial, commercial/services, and residential land use) and Pompton Lake; and to the west and northwest by Twin Lake Valley (commercial/services and residential land use) and the Borough of Wanaque.

The Site is divided into the following three former manufacturing areas (Figure 1):

- Eastern Manufacturing Area (EMA) which is further broken into the northern, middle, and southern portions on the eastern (Acid Brook Valley) side of the Site;
- Northern Manufacturing Area (NMA) located north of I-287 along the Wanaque River; and
- Western Manufacturing Area (WMA) located south of I-287 along the Wanaque River.

In the late 1800s, the H. Julius Smith Blasting Cap Plant and the American Smokeless Powder Plant operated in the western portion of the Site, and the Metallic Cap Company operated in the eastern portion. In 1902, DuPont purchased the Site and began operation of the DuPont Electric Exploder Company in the WMA. In 1908, DuPont opened the DuPont Cap Works in the EMA. DuPont ceased production in the WMA in 1926 and consolidated operations in the EMA. From that time until April 1994 when operations permanently ceased, DuPont production activities manufactured a variety of explosive products.

2.2 Current Use (Site and Offsite)

The portion of the Site located in the Borough of Wanaque is designated as Preservation Area under the New Jersey Highlands Water Protection and Planning Act. This section of the property includes the NMA, northern and central portions of the WMA, and northernmost section of the EMA adjacent to I-287. The Site land use designation within the Borough of Pompton Lakes is industrial; however the Site is not used for any industrial activities. Manufacturing activities ceased in 1994 and a majority of the Site buildings in the EMA, NMA, and WMA were demolished; leaving the former foundations in place. Land use within 1,000 feet of the Site is principally recreational with some residential, small business, and light industrial areas.

3.0 CONCEPTUAL SITE MODEL

A CSM was developed for the Wanaque River in the vicinity of the Site based on information presented in the revised RIR (URS, 2011), Technical Status Report (URS, 2012), and supplemental investigations conducted in the WMA (O'Brien & Gere, 2012; URS, 2013). The CSM describes and evaluates the physical and chemical attributes of the Wanaque River along with potential contaminant migration pathways to the river and potential in-stream fate and transport processes for Site-related constituents that may have migrated to the river. The following sections present a summary of the CSM based on investigations conducted to date.

3.1 Surface Water and Sediment Features

One of the major drainage areas of the Site is the Wanaque River (former Lake Inez) that flows north to south through the WMA. The river originates in New York state and flows through multiple impoundments including Greenwood Lake (Greenwood Lake, New York and West Milford, New Jersey), Monksville Reservoir (Monks, New Jersey), and Wanaque Reservoir (Wanaque, New Jersey). From the discharge of the Wanaque Reservoir at Raymond Dam, the Wanaque River flows approximately 2 miles south to the Site. Approximately 1.5 miles south of the Site, the Wanaque River joins with the Pequannock River.

Prior to 1984, there was a dam across the Wanaque River, located downstream of the southern Site boundary and north of the Wanaque Avenue Bridge. This dam formed Lake Inez, which inundated low lying areas of the Wanaque River Valley. The U.S. Army Corps of Engineers removed a portion of the dam in 1984, which resulted in the draining of Lake Inez and the return of the Wanaque River to its channel.

Currently, water flow downstream of the Wanaque Reservoir is controlled by the Raymond Dam. The dam operates as an uncontrolled spillway when the reservoir elevation exceeds an elevation of 302.4 feet above mean sea level; however, a daily minimum volume is discharged from the dam to maintain base flow downstream in the Wanaque River. Base flows during minimum maintenance discharge are generally 18 to 20 cubic feet per second (cfs), as measured at the U.S. Geological Survey (USGS) gauging station immediately downstream of the Raymond Dam (USGS 01387000 Wanaque River at Wanaque, New Jersey).

Within the Site, the river flows through a valley characterized by steep bedrock slopes along the eastern and western banks. Valley topography is relatively flat in the immediate vicinity of the river, with the floodplain widening considerably in the northern portion of the valley. Within the proposed IRM area, the Wanaque River width is variable, ranging from approximately 40 feet wide in the northern portion to 100 feet wide in the section upstream of the former dam. The river is relatively shallow with depths generally less than 2 feet.

The reach of the Wanaque River that flows between the Raymond Dam and the Wanaque Avenue bridge, which includes the Site, is classified by NJDEP as trout production waters (Category One); downstream of the Wanaque Avenue bridge, the Wanaque River is classified as trout maintenance waters (N.J.A.C. 7:9B, last amended April 4, 2011).

Aquatic habitat in the Wanaque River varies from the Wanaque Reservoir upstream of the Site to the confluence of the Pequannock River downstream of the Site. Based on the preliminary habitat characterization/substrate mapping conducted during the RI, Reach 1 and the upper two-thirds of Reach 2 are characterized by riffle/run/pool complexes that are associated with cobble/gravel substrates across most of the channel transect. Fine-grained sediment deposits in the upper portion of Reach 2 are generally limited to the channel margins, particularly in areas where flow is impeded by an obstruction. Flow in the lower third of Reach 2 is reduced by the remnants of the former dam. Within this portion of Reach 2, the channel broadens, water velocity is reduced, and sediment accumulates across the channel resulting in embedded substrates. The area upstream of the former dam represents a zone of sediment deposition, where the most substantial deposits of fine-grained sediments have accumulated. Substrate types in this area range from silt to embedded cobble/gravel. Downstream of the former dam in Reach 3, the river generally returns to the riffle/run/pool structure observed upstream of the Site. Depositional sediment features in Reach 3 are limited to the channel margins and areas where flow is impeded by an obstruction.

Detailed substrate mapping was conducted in February 2012 in Reach 2 from sampling station WR-16 to WR-13 and Reach 3 below the former dam downstream to station WR-22 to define the spatial extent of fine-grained sediment deposits within the channel (Figure 3; URS, 2012). The findings of the substrate mapping indicated that fine-grained sediments, defined as silts and clays (<0.064 millimeter [mm] particle size), comprise only 5% of the mapped area of the river, with substrates predominated by fine sands representing an additional 5% of the available benthic habitat. Over 83% of the mapped area was predominantly coarse substrates with particle sizes greater than 4 mm (URS, 2012).

3.2 Potential Migration Pathways to the Wanaque River

The CSM developed for the Wanaque River indicates that the primary contaminant transport pathway from former Site operations to the river is historical soil migration from the adjacent uplands and floodplain. Extensive investigations of Site-related constituents in upland and floodplain soils within the former manufacturing areas have been conducted as part of the completed RIs of the Site (Parsons, 2010a and Parsons, 2010b). These investigations indicate that Site-related metals, particularly mercury, copper, and lead, were detected in surficial upland and floodplain soils at concentrations exceeding ecological benchmarks and ambient soil concentrations.

The relatively stable condition of the banks and vegetated adjacent floodplains that currently exist within the Site suggests that the accumulation of particulate-bound COPECs, particularly mercury, upstream of the former dam was predominately associated with historical surface migration pathways during a period of less soil stability or due to different hydrologic conditions influenced by the former dam. Qualitative habitat characterization and substrate mapping surveys were conducted in November 2009, November 2010, and February 2012 to identify important features in potential transport pathways from adjacent upland and floodplain areas. The evaluation of floodplain features indicated that most soil disturbances in the WMA were limited to the upper portion of Reach 2. In the lower section of Reach 2, where the greatest concentrations of mercury and other COPECs were observed in adjacent floodplain and upland soil samples (Parsons 2010b), stream banks were predominately vegetated and stable.

Data from groundwater investigations conducted in the WMA indicate that groundwater is not impacted by mercury concentrations in soil and that the migration of impacted groundwater to the Wanaque River is not a significant transport pathway for mercury. As summarized by URS (2013), potential migration pathways of mercury-impacted groundwater to the Wanaque River were evaluated based on the findings of the *Supplemental Onsite Groundwater Investigation Report* (O'Brien & Gere, 2012). Mercury concentrations in 10 of 12 unfiltered shallow groundwater samples (< 25 feet below the ground surface [bgs]) collected in the WMA, most within 100 feet of the river bank, were below detection limits (URS, 2013; O'Brien & Gere, 2012). None of the filtered samples collected from these shallow groundwater wells contained detectable concentrations of mercury. The absence of detectable mercury concentrations in nearly all unfiltered samples and all filtered samples from these shallow groundwater samples indicates that groundwater-surface water migration is not a significant transport pathway for mercury from soils in the WMA to the Wanaque River.

In summary, elevated concentrations of mercury in adjacent upland and floodplain soils within the WMA likely migrated to the river primarily through surface transport mechanisms during periods of less soil stability. Based on groundwater samples collected during investigations completed in the WMA, mercury detected in soil have not impacted groundwater quality; thereby indicating that the migration of groundwater is not a significant transport pathway for mercury.

3.3 Potential In-Stream Fate and Transport Processes

Particulate-bound mercury that entered the river accumulated in the area of low water velocity created by the former dam and along channel margins. Particulate-bound mercury may have also accumulated in bank soils, which may have been subsequently released back to the river during periods of high flows and bank instability. Elevated concentrations of mercury and other COPECs detected in sediment between sampling station WR-16 and the remnants of the former dam are likely attributed to the accumulation of these historically-released fine-grained sediments upstream of the former dam (Figure 4). This fine-grained deposit represents the area of greatest potential ecological exposure due to the elevated concentrations of COPECs and the potential for mercury methylation, as discussed further below. Upstream of WR-16, areas of elevated sediment THg concentrations were associated with spatially-limited fine-grained sediment deposits at the channel margins (Figure 5).

Downstream of the former dam in Reach 3, sediment depositional features are limited (5-10% of river surface area) as the river returns to the riffle/run/pool structure observed upstream of the Site (Figures 6 and 7). As illustrated by the results of the detailed mapping survey conducted in February 2012, fine-grained sediment deposits in this reach are generally limited to the channel margins and areas downstream of obstructions. Consistent with the change in sediment depositional patterns, concentrations of mercury in sediment are lower (below the NJ RDCSRS) than in sediment upstream of the former dam (Figures 6 and 7).

In-stream characteristics and processes influence the fate and transport of mercury within the Wanaque River, particularly methylation processes associated with mercury bioaccumulation and toxicity. Mercury methylation, a biochemical reaction where inorganic mercury is methylated by anaerobic bacteria, including sulfate-reducing (Compeau and Bartha, 1985) and iron-reducing bacteria (Fleming et al., 2006) in anoxic regions of aquatic systems, is an important component of the fate and transport of mercury in aquatic systems (Benoit et al., 2003). Methylmercury (MeHg) has different chemical, physical, and toxicological properties compared to inorganic mercury; therefore, the form of mercury present in the environment is an important consideration in the evaluation of mercury toxicity and bioaccumulation. In a fluvial system such as the Wanaque River, in-stream areas where mercury methylation could potentially occur include fine-grained sediment deposits located within the channel or the hyporheic zone (Stoor et al., 2006).

Evaluation of surface water data collected during the RI indicates that MeHg is present throughout the study area and that mercury methylation may be associated with fine-grained sediment deposits upstream of the former dam (URS, 2011). Coincident with the zone of fine-grained sediment deposition upstream of the former dam, concentrations of filtered and unfiltered MeHg in surface water samples collected from stations in the lower section of Reach 2 were elevated relative to upstream stations (Figure 8). Increased MeHg concentrations in surface water samples collected from the lower section of Reach 2 may be indicative of mercury methylation in fine-grained sediment deposits upstream of the former dam (URS, 2011).

3.4 Potential Exposure

Mercury that is present in environmental media within the Wanaque River may result in exposure to ecological and human receptors. This subsection describes the evaluation of potential ecological and human health exposures based on available data presented in the revised RIR (URS, 2011) and Technical Status Report (URS, 2012).

Ecological investigations conducted in the Wanaque River to date indicate that direct contact exposures to mercury in surface water and sediment, as evaluated based on pore water data, are not likely to result in adverse effects to ecological receptors. Concentrations of THg and MeHg measured in multi-phase surface water investigations were below conservative, chronic surface water quality benchmarks for the protection of aquatic life (e.g., NJSWQS, Canadian Water Quality Guideline), indicating that adverse effects to aquatic organisms through direct contact exposures are not likely (URS, 2011).

The evaluation of direct contact exposures to sediment-dwelling receptors indicates that adverse effects due to mercury are not likely. Direct contact exposure of benthic invertebrates to mercury in sediment was evaluated based on exposure to pore water because measurements of constituent concentrations in pore water provide direct information regarding the fraction of sediment-associated contaminants that are likely to be most available to ecological receptors (USEPA, 2002). Pore water data collected in supplemental investigations in August 2012, in areas upstream of WR-16 and downstream of the former dam, indicated that THg and MeHg concentrations measured in 17 of 18 pore water samples were lower than conservative surface water quality standards established for the general protection of aquatic life. Maximum concentrations of THg and MeHg measured in pore water did not exceed literature-derived aqueous toxicity effects values (URS, 2012). Furthermore, pore water concentrations were lower than conservative surface water quality standards in all 16 samples collected from stations with sediment THg concentrations exceeding the SEL of 2 milligrams per kilogram (mg/kg) derived based on direct contact exposure to benthic invertebrates. These findings indicate that THg and MeHg in pore water are not likely to result in adverse effects to sediment-dwelling receptors and that the SEL is not likely a reliable threshold for identifying mercury-associated, direct contact effects to those receptors.

These evaluations indicate that direct contact exposures of aquatic and sediment-dwelling receptors to mercury in surface water and sediment are not likely to result in adverse ecological effects. However, the potential bioaccumulative effects of mercury on aquatic and semi-aquatic receptors have not been evaluated as part of investigations conducted to date. As described in Section 4.2.4, an additional investigation will be conducted as part of the pre-IRM activities to evaluate potential bioaccumulation of mercury into fish tissue in the Wanaque River study area.

Potential direct contact exposure is the primary human health exposure pathway to sediments in the project area as a result of trespassers entering the area for recreational purposes. Although human-health based NJ RDCSRS are not directly applicable to sediment data, areas with sediment concentrations exceeding NJ RDCSRS may represent a direct contact exposure. Sediments with THg concentrations exceeding NJ RDCSRS were generally limited to the area of sediment deposition downstream of WR-16 to the former dam (Figure 4) and in limited sediment deposits along channel margins upstream of WR-16. No sediment samples collected downstream of the former dam contained THg concentrations exceeding the NJ RDCSRS (Figure 6).

3.5 Conceptual Site Model Summary

The CSM indicates that fine-grained sediment deposits identified between sampling station WR-16 and the remnants of the former dam and in limited areas along channel margins upstream of WR-16 to WR-13 represent the areas of greatest potential ecological and human-health exposure due to elevated concentrations of mercury in sediment. Evaluation of surface water and sediment pore water data indicate that adverse effects to ecological receptors through direct contact exposure to mercury in surface water and sediment is not likely; however, the potential bioaccumulative effects of mercury on aquatic and semi-aquatic receptors were not evaluated as part of the RI. Sediment samples collected at select stations within fine-grained sediment deposits upstream of the former dam contained THg concentrations exceeding human-health based NJ RDCSRS; no sediment samples collected downstream of the former dam contained THg concentrations exceeding the NJ RDCSRS.

The evaluation of surface water data indicates that mercury methylation and potential bioaccumulation may be associated with the fine-grained sediment deposits upstream of the former dam. Increased concentrations of MeHg in surface water samples were coincident with the zone of fine-grained sediment deposition upstream of the former dam. A fish tissue study will be conducted as part of pre-IRM activities to evaluate potential mercury bioaccumulation pathways associated with fine-grained sediment deposits within the project area.

Historical migration of mercury and other COPECs from upland soils impacted by former Site operations was likely the primary contaminant transport pathway to the Wanaque River. The stable condition of the banks and vegetated adjacent floodplains that currently exist in Reach 2 suggests that the accumulation of particulate-bound COPECs in the depositional area upstream of the former dam was predominately associated with historical migration pathways during a period of less soils stability. Data from groundwater investigations conducted in the WMA indicate that groundwater is not impacted by mercury concentrations in soil and that the migration of impacted groundwater to the Wanaque River is not a significant transport pathway for mercury.

Based on the current CSM, an IRM is being proposed to address mercury concentrations in fine-grained sediments that have accumulated in Reach 2 between sampling station WR-16 and the remnants of the former dam and in limited areas along channel margins upstream of WR-16 to WR-13. Section 4 presents details regarding the IRM objectives and approach for implementation.

4.0 WANAQUE RIVER SEDIMENT INTERIM REMEDIAL MEASURE

The overall objective of the IRM is to remove fine-grained sediments north of the former Lake Inez dam impacted by mercury at concentrations greater than the NJ RDCSRS; thereby, mitigating the potential human health direct contact exposure to mercury in depositional sediments and reduce the exposure area for ecological receptors.

4.1 Interim Remedial Measure Remedial Action Objectives

RAOs are media-specific goals that are established for the remedial action to be protective of human health and the environment. Sediment is the primary medium of concern. Mercury-impacted sediment, primarily associated with fine-grained sediment deposits, could result in a potential exposure to human and ecological receptors. Based on the CSM, and data and information collected during the RI, the following RAOs were established for the IRM:

- Reduce potential direct contact human health exposure to impacted sediments with mercury concentrations exceeding the NJ RDCSRS.

- Reduce the area for ecological receptors exposed to elevated concentrations of mercury in fine-grained sediment deposits.

- Stabilize or remediate locations outside of the proposed IRM area (i.e., river bank soils, channel margin deposits) that may erode and represent a potential source to downstream areas.

The following is a summary of the rationale and information used to define the RAOs. Media of concern, mercury transport, exposure pathways, potential receptors, and applicable regulatory standards were evaluated during the development of the RAOs.

Fine-grained sediments are the primary medium of concern for this IRMWP, for the protection of human health and the environment, due to elevated mercury concentrations in sediment and the potential for mercury methylation. As identified in the CSM, particulate-bound mercury historically transported from adjacent floodplain and upland soils accumulated in fine-grained sediment deposits between sampling station WR-16 and the remnants of the former dam and in limited areas along channel margins upstream of WR-16 to WR-13. Concentrations of mercury associated with these fine-grained sediment deposits exceed the NJ RDCSRS and represent the greatest area of potential ecological exposure due to the potential for mercury methylation. Based on the conceptual mercury transport pathway, bank soils and adjacent floodplain soils are included with fine-grained sediments as media of concern to mitigate the potential of re-impacting areas addressed by the IRM. Surface water is not considered a medium of concern because concentrations of filtered and unfiltered mercury and other Site-related metals were below chronic surface water criteria for the protection of aquatic life (i.e., NJSWQS, NRWQC); therefore, no unacceptable risks to aquatic life were identified for surface water exposure (URS, 2011).

NJDEP does not currently have promulgated sediment standards for the protection of ecological receptors. Ecological screening criteria (ESCs) for sediments that are compiled by NJDEP (NJDEP, 2012), including the SEL, do not represent remediation standards but general sediment quality guidelines for evaluating potential direct contact toxicity to sediment-dwelling receptors. As stated in the CSM, direct contact exposures to THg and MeHg concentrations in pore water at stations with sediment concentrations exceeding the mercury SEL were not associated with adverse effects to sediment-dwelling receptors. This finding indicates that the SEL is not likely a reliable threshold for identifying mercury-associated, direct contact effects to those receptors; therefore, the SEL is not an appropriate basis for a remediation standard. Further evaluation of the potential bioaccumulative effects of mercury will be conducted as part of pre-IRM activities and the results will be used to evaluate the protectiveness of the IRM for bioaccumulation pathways.

There are no promulgated standards in New Jersey for the protection of potential direct contact human health exposure pathways to sediment. As a result, the NJ RDCSRS for mercury (23 mg/kg) will be used as a conservative remediation standard for those areas identified for remediation due to the potential for river sediment to be re-deposited along the river bank or shoreline during flooding events, where it may then be contacted by potential receptors (trespassers or recreational users). This remediation standard is conservative for the protection of human health because potential direct contact exposure to sediments along the river bank or shoreline will likely be more infrequent than the daily exposure assumed in the derivation of the NJ RDCSRS.

4.2 Pre-IRM Activities

Supplemental field activities will be completed prior to the implementation of the IRM in order to finalize the remediation limits of the areas north of the IRM boundary, confirm the feasibility of the IRM implementation approach, evaluate the potential for mercury bioaccumulation, and define the boundaries of the river bed. A description of each activity is provided below. The results of the pre-IRM activities will be summarized and submitted as an addendum to the IRMWP.

4.2.1 Supplemental Sediment Sampling

The supplemental investigation sampling conducted in 2011 and 2012 identified five sediment samples collected in fine-grained deposits north of the proposed IRM boundaries with mercury concentrations greater than the NJ RDCSRS (see Figure 5). These locations represent spatially-limited deposits at the channel margins and additional surficial sediment sampling for mercury analysis is proposed to define these areas for inclusion with the removal action proposed for the IRM. Proposed sample locations are depicted on Figure 5. Sediment samples will be collected from fine-grained deposits, where present, using a sampling method consistent with previous phases of sampling, which was based on general guidance and principles outlined in USEPA's *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (USEPA, 2001) and NJDEP's *Ecological Evaluation Technical Guidance* (NJDEP, 2012). Sediments will be analyzed for THg using USEPA Method 7471A.

Additional sediment analyses will include grain size distribution and total organic carbon (TOC). Table 1 presents a summary of the proposed sediment sampling program.

4.2.2 Bank Soils Evaluation

Analytical data collected during the WMA RI adjacent to the proposed IRM and fine-grained sediment deposits north of the IRM will be reviewed to identify bank soils that present the greatest potential to re-deposit particulate-bound mercury within the Wanaque River. In addition, observations regarding bank stability made during habitat characterization and substrate mapping efforts will be reviewed to identify potential areas of soil instability that may represent a source to the river. If necessary, additional sampling may be conducted to further characterize these areas. Bank locations identified as having the potential to re-deposit soils into the Wanaque River will be addressed during the IRM through a removal or stabilization measure. Results of this evaluation will be submitted for review and approval prior to implementing any remedial measure.

4.2.3 Geotechnical Investigation

A geotechnical investigation will be completed to assess the structural stability of the river bed as well as to provide geotechnical data required for the design of the IRM river water bypass system (i.e., sheet pile wall or portadam). The geotechnical investigation will consist of drilling three borings to a maximum depth of 20 feet along a transect perpendicular to flow across the channel near the approximate upstream extent of the IRM project area (Figure 9). Geotechnical borings will be drilled by a licensed New Jersey well driller.

Standard penetration test (SPT) values will be recorded and soil samples will be retained from the borings in the event that additional geotechnical testing on the material is deemed necessary. At the completion of the investigation, retained samples will be returned to the prospective remediation contractor (Contractor). In addition to the geotechnical samples collected, analytical samples will be collected at each boring location from the coarse-grained sediments in the river bed immediately below the fine-grained sediments that have accumulated as a result of the former dam. Bulk sediment samples collected from the 6-inch interval immediately below the fine-grained sediments will be homogenized in decontaminated stainless steel mixing bowls and placed into laboratory-supplied containers for analysis. Sediments will be analyzed for THg using USEPA Method 7471A. Additional sediment analyses will include grain size distribution and TOC. Table 1 presents a summary of the proposed geotechnical program.

4.2.4 Fish Tissue Survey

In response to NJDEP comments on the Technical Status Report, a fish tissue survey has been proposed for the Wanaque River study area to evaluate potential mercury bioaccumulation. As recommended by the NJDEP BEERA comments on the Technical Status Report received on February 27, 2013, species with a limited home and foraging range will be targeted for tissue analyses. Representative samples will be targeted from one forage species within each of the following fish feeding guilds and habitat types:

- Benthic invertivores (e.g., darters, dace, sculpin, etc.) primarily inhabiting riffle habitats; and
- Omnivores (e.g., shiners, fallfish, etc.) primarily inhabiting pools and channel margins.

Fish tissue samples will be collected from targeted sampling reaches (e.g., 50-100 meter sampling reach) established within 5 proposed sections of the study area (see Figure 9):

- Reach 1: Upstream of the Site in the vicinity of WR-08;
- Reach 2: Upstream of the IRM area between WR-10 and WR-11;
- Reach 2: Upstream of the IRM area between WR-16 and WR-13;
- Reach 2: Within the IRM area in the vicinity of WR-18; and
- Reach 3: Downstream of the Site in the vicinity of WR-19.

Mercury concentrations in fish tissue within the study area will be evaluated based on the following:

- Comparisons of mercury concentrations measured in fish tissue collected in sampling Reaches 2 and 3 relative to concentrations measured in fish tissue upstream of the Site in Reach 1;

- Comparisons of mercury concentrations in fish tissue to literature-based critical body residue (CBR) concentrations representative of effects on growth and reproduction in fish species relevant to the Wanaque River; and

- Comparisons of mercury concentrations in fish tissue to calculated fish tissue thresholds that are protective of avian piscivores potentially consuming fish within the study area.

As requested by NJDEP BEERA during a conference call on March 28, 2013, fish tissue sampling will also include the collection of trout samples for THg analysis to evaluate potential human health exposure via fish consumption. If trout are encountered during sampling in the targeted reaches specified above, similar-sized individual samples will be retained and processed for skin-on filet analyses of THg. If trout samples are collected from tissue sampling reaches within study Reaches 2 or 3, additional sampling for trout will be conducted upstream of the Site or from hatchery sources to establish baseline mercury concentrations in trout tissue. If trout are not encountered in the targeted sampling reaches identified above, it will be concluded that the human health fish consumption pathway for trout is incomplete within the project area.

Samples will be collected in accordance with NJDEP's *Ecological Evaluation Technical Guidance* (August 2012) and under a project-specific NJDEP *Scientific Collecting Permit for Freshwater Fish*. Specific details regarding study design, sampling procedures, and sample analyses will be provided to NJDEP in a brief technical scoping memorandum prior to mobilizing to the field.

4.2.5 Wanaque River Bed Survey

A survey of the Wanaque River will be completed to define the boundaries and bottom of the river bed. Survey work will consist of the collection of three data points (centerline and both banks) along the entire stretch of the river within the proposed IRM boundaries. Data points will be collected at a 50- to 100-foot spacing, as well as at key changes in the river width and direction. At each data point, coordinates will be collected in the New Jersey State Plane Coordinate System (NAD-83) and elevations will be collected in North American Vertical Datum (NAVD-88). Results of the survey will be incorporated into the final limits of the IRM.

4.3 Interim Remedial Measure Implementation

The preliminary design for the IRM implementation involves removal of fine-grained sediment within the Wanaque River at mercury concentrations greater than the NJ RDCSRS.

Fine-grained sediment within the proposed IRM boundary (see Figure 4) will be excavated, managed, and transported to an approved disposal facility. Available data indicate that sediment excavated from within the proposed IRM area may be managed as non-hazardous waste. Nine samples collected within the potential IRM area were analyzed for sediment toxicity characteristic and leaching procedure (TCLP) during supplemental sediment sampling in December 2011. The results of TCLP analyses did not indicate concentrations exceeding NJDEP regulatory levels for any metals (Table 2). Additional waste characterization may be conducted on excavated materials prior to disposal.

To efficiently complete excavation activities, the Contractor will bypass the river flow around the excavation area. The bypassed area (work zone) will be dewatered, allowing excavation activities to be completed in drier conditions. Excavation of fine-grained sediment will be completed from within the work zone rather than from the river bank and may require the use of matting and/or temporary stabilization of the river bed for equipment access. The excavation will progress in a general north to south direction with any bank excavation completed concurrently with adjacent channel sediment. Excavated sediment will be transported to a staging area on the Site for stabilization and sampling prior to offsite disposal.

The spatially-limited deposits at the channel margins north of the main IRM area will be removed from outside of the river. The preliminary design for these areas includes installation of roads along the top of the banks for construction equipment to access these areas. From the access road, the Contractor will install barriers around the work zone to control the river water and complete excavation activities. Additionally, bank soils north of the proposed IRM area will be addressed through excavation or stabilization. Upon completion of the bank soils evaluation, remedial measures, if required, for bank soils will be incorporated into the IRMWP addendum.

The Wanaque River flow will be bypassed around the work zone using multiple dri-prime pumps with suction and discharge piping. The pumps will be operated on a lead-lag basis to maintain the minimum necessary pumping capacity to manage the river water flow volume. A diversion dam will be installed upstream of the work zone and a backfill dam will be installed downstream. The river will be protected at the discharge end of the bypass piping with an energy dissipater to prevent scouring. Dewatering operations inside the work zone will be continually operated to provide a drier bottom for excavation. Water from inside the active excavation will be managed to ensure compliance with applicable permits.

Bank soils, if removed, will be restored and vegetated. The removal of fine-grained sediments will re-establish a desirable coarse-grained substrate. Additional restoration activities, if necessary, will be completed in accordance with permits required for the IRM implementation.

A detailed implementation and operations plan will be submitted with the IRMWP addendum that will include final IRM limits, the results of the pre-IRM activities, health and safety plan, site preparation description, erosion and sediment control procedures, excavation and sediment management plan, monitoring plan, water management and treatment plan, and restoration requirements.

4.4 Monitoring Program

Monitoring activities will be performed prior to and during excavation, material handling and processing, and restoration. Baseline monitoring will be conducted, as required, to establish pre-IRM conditions and assess any potential impacts from IRM implementation. The anticipated monitoring program may include air monitoring, monitoring of bypass water and treated excavation water prior to discharge, and vibration monitoring. Specific conditions for monitoring are anticipated to be defined during the permitting process.

Air monitoring is anticipated to be conducted only during material handling and processing within the staging area. Even though the excavation will be dewatered, the material to be excavated is anticipated to have a sufficient moisture content to prevent generation of dust. If dewatering operations start to reduce sediment moisture content to a level that may cause dust generation, an air monitoring program within the work zone and on the perimeter of the excavation will be implemented. A formal air monitoring plan for material handling, processing, and, if required, excavation will be included within the operations plan portion of the IRMWP addendum.

As discussed in Section 4.3, water from inside the active excavation and the stockpile management area will be collected and managed using an onsite temporary water system. It is anticipated that water will be monitored and sampled, if required, prior to discharge back into the river to ensure compliance with applicable permits. A water management, monitoring, and testing program will be developed based on permit requirements for the IRM and included within the operations plan.

5.0 PERMITTING AND OTHER APPROVALS

Investigative, remedial, and restoration activities in the Wanaque River project area will likely require authorizations and approvals from state and local authorities for temporary disturbances within regulated areas. The following list of potential permits and approvals was developed based on a preliminary review of regulatory requirements for the conceptual IRM activities described in the previous section.

State

- NJDEP Wetlands General Permit #4 – Hazardous Investigation and Clean-Up (90-180 days regulatory review)
- NJDEP Flood Hazard Individual Permit
- NJDEP New Jersey Pollutant Discharge Elimination System Surface Water Discharge Permit (BGR – General Remediation Clean-up Permit Authorization)
- NJDEP Air Quality Permitting Program – General Permit
- NJDEP Highlands Applicability & Water Quality Management Plan Consistency Determination/Preservation Area Exemption
- NJDEP Water Allocation Permit-by-Rule – Determination
- NJDEP Stormwater Construction General Permit (RFA)
- NJDEP Historic Preservation Office Phase 1A Cultural Resources Investigation
- Scientific collection permit (for fish collection)

Local

- Passaic County Soil Erosion and Sediment Control Approval
- Pompton Lakes and Wanaque Borough Soil Removal Permits / Minor Site Plan Approval

A refined list of permit requirements and construction approach will be determined after the NJDEP pre-application meeting and may result in a modification to this list of permitting requirements and approvals.

6.0 PROJECT SCHEDULE

Based on the preliminary IRM design and results of the investigations summarized in the Technical Status Report, supplemental work and permitting will need to be completed to finalize and implement the IRM. Upon approval of this IRMWP, the supplemental work will be conducted concurrently with the permitting process to achieve the goal of implementing the IRM.

Preliminary schedules prepared for the pre-IRM and IRM are included below. Separate schedules have been prepared based on permitting and regulatory requirements. Milestones and critical path activities have been identified in bold and highlighted in blue on the schedule. Time frames for each activity are estimated.

<u>Pre-IRM Activities</u>

The following is an estimated schedule to complete pre-IRM activities. Field activity time frames include task preparation, implementation, data reduction, and reporting.

Pre-IRM Implementation Schedule	**2013**					
	Month 1	**Month 2**	**Month 3**	**Month 4**	**Month 5**	**Month 6**
Receipt of NJDEP IRMWP Approval						
Pre-IRM Activities						
Supplemental Sediment Sampling						
Bank Soils Evaluation						
Geotechnical Investigation						
Fish Tissue Survey						
River Bed Survey						
Permitting						
IRM Supplemental Design						
IRMWP Addendum Preparation						
Submittal of IRMWP Addendum to NJDEP						

<u>IRM Implementation</u>

The following is an estimated schedule for the IRM implementation which incorporates the following:

- Regulatory restrictions within the Wanaque River due to its classification as trout production waters – restricted activities between September 15 and March 15; and
- Preference for conducting the IRM during periods of low flow within the Wanaque River.

A revised schedule will be included in the IRMWP Addendum.

IRM Implementation Schedule	2013		2014									
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Receipt of NJDEP IRMWP Addendum Approval												
IRM Implementation												
Mobilization												
Implementation												
Demobilization												
IRM Report Preparation												
Submittal of IRM Report to NJDEP												

7.0 REFERENCES

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TABLES

Table 1
Proposed Supplemental Sediment Sampling Tasks
Wanaque River Interim Remedial Investigation Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

Investigation Task	Depth Interval	Sampling Device	Measured Parameters	Location	Number of Samples
Characterization of sediments in fine-grained deposits to define the extent of the IRM	Surficial grab	Petite Ponar	**Analytical:** THg: USEPA 7471A TOC: Lloyd Kahn Grain size: ASTM D422 ***In situ* surface water parameters**: Temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential	**Reach 2:** Upstream of potential IRM to WR-13 (Figure 5)	15
Characterzation of mercury concentrations in sediment immediatedly below the fine-grained sediment layer	6-inch depth interval immediately below the fine-grained sediment deposts	Geotechnical boring	**Analytical:** THg: USEPA 7471A TOC: Lloyd Kahn Grain size: ASTM D422	**Reach 2:** Upstream of IRM Boundary (Figure 9)	3

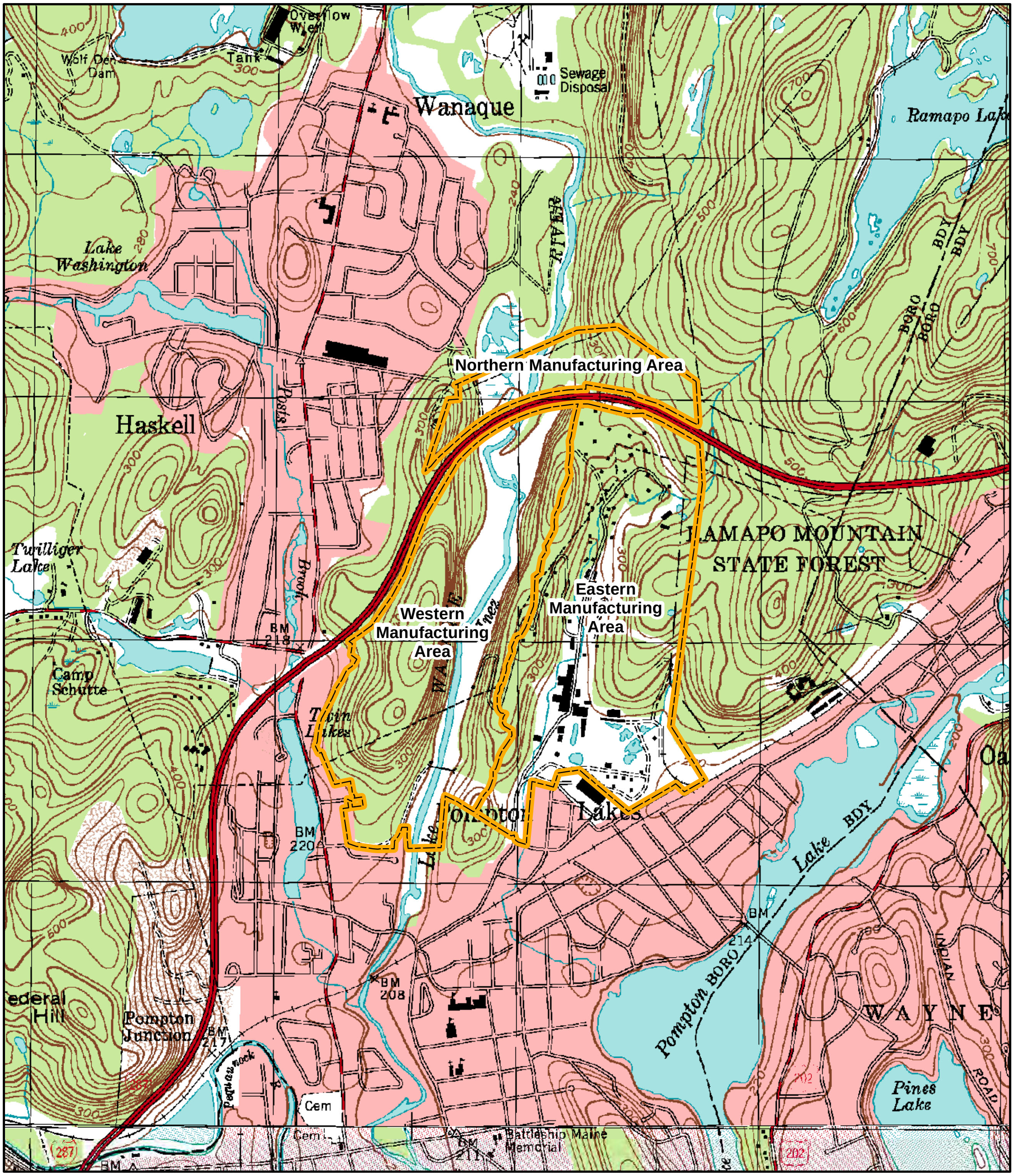
Notes:
IRM: Interim remedial measure
THg: Total mercury
TOC: Total organic carbon

Table 2
Summary of Sediment Toxicity Characteristic and Leaching Procedure (TCLP) Results
Wanaque River Interim Remedial Investigation Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

Analyte	Regulatory Level[1] (µg/L)	Station	WR16.2-B	WR16-B	WR16TCLP	WR17ATCLP	WR17BTCLP	WR17CTCLP	WR17-E	WR17TCLP	WR18TCLP
		Date	11/9/11	11/9/11	11/9/11	11/9/11	11/10/11	11/10/11	11/9/11	11/9/11	11/10/11
		Interval (in)	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6
Arsenic	5,000		55.4	6.9 J	<5.1	<5.1	176	164	<5.1	144	102
Barium	100,000		316	634	194	170	623	464	179	517	452
Cadmium	1,000		6.2	1.7 J	0.78 B	0.7 B	4.6 J	1.7 B	<0.27	2.3 J	2.3 J
Chromium	5,000		2.7 J	2.6 J	1.8 J	<1.1	2.9 J	3.2 J	<1.1	3.8 J	3.5 J
Lead	5,000		672	76	3 J	26.3	644	212	5.2 J	335	715
Selenium	1,000		<6.9	<6.9	<6.9	<6.9	<6.9	<6.9	<6.9	<6.9	<6.9
Silver	5,000		<0.91 UJ	<0.91 UJ	<0.91	<0.91	1 J	<0.91	<0.91 UJ	<0.91	<0.91
Mercury	200		0.073 J	<0.026 R	0.068 B	123	0.13 B	2.6	8.4 J	0.15 B	0.073 B

Notes:
1, NJDEP Waste Classification Request Form & Instructions (HWM-009; revised 11/23/10)
B, Not detected substantially above the level reported in the laboratory or field blanks
UJ, Not detected. Reporting limit may not be accurate or precise.
J, Analyte present. Reported value may not be accurate or precise.

FIGURES



Legend

Former Manufacturing Area

0 1,000 2,000 4,000 Feet

1 inch = 2,000 feet

Reference:
USGS Togographic Quadrangles
Wanaque, NJ 2000
Pomptain Plains, NJ 1998

Passaic
Bergen
Morris

URS

Job:	
Prepared by: RRM III	
Checked by: DR	
Date: 07/19/2010	

Figure 1
Site Location Map
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

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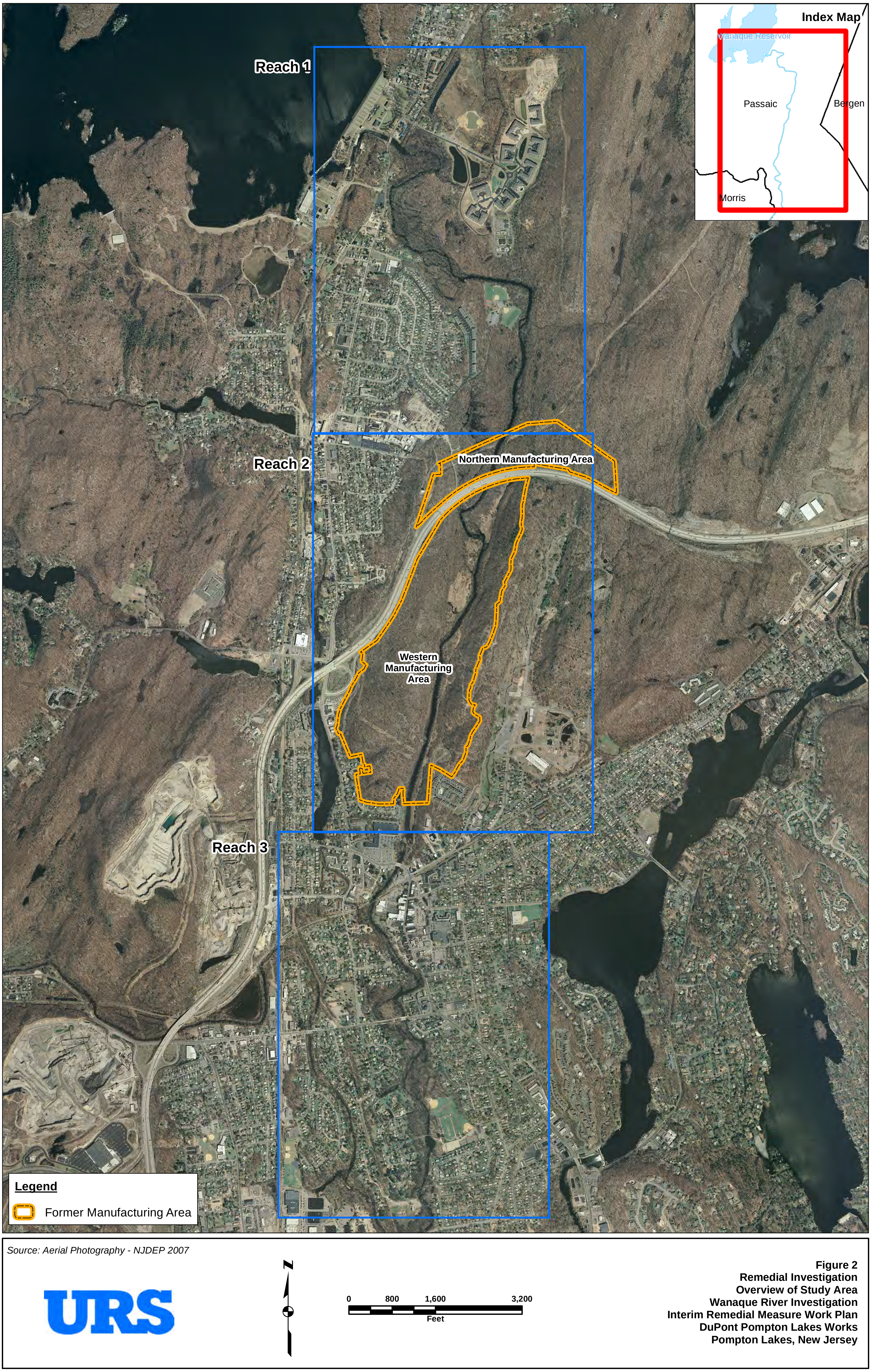
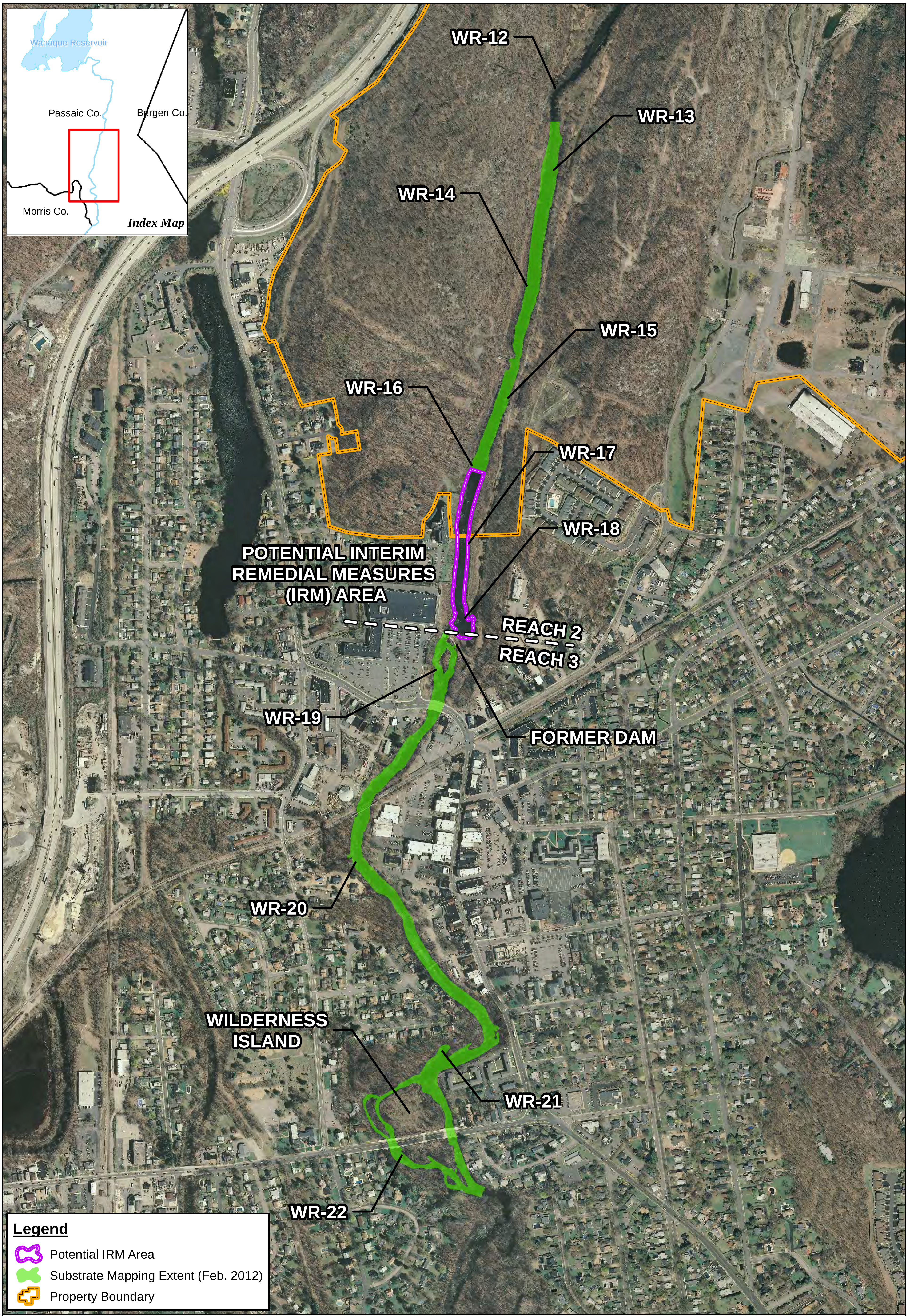
WanaqueRiverRIR\DuPont Pompton Lakes Wanaque Valley RIR Figure 1.mxd



Source: Aerial Photography - NJDEP 2007

URS

Figure 2
Remedial Investigation
Overview of Study Area
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey



Source: Aerial Photography - NJDEP 2007

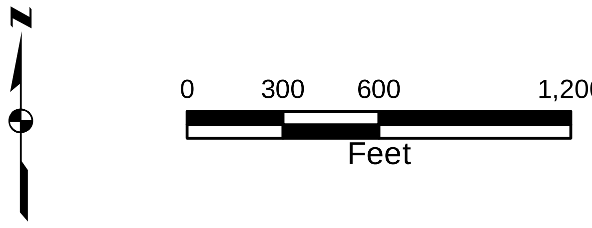
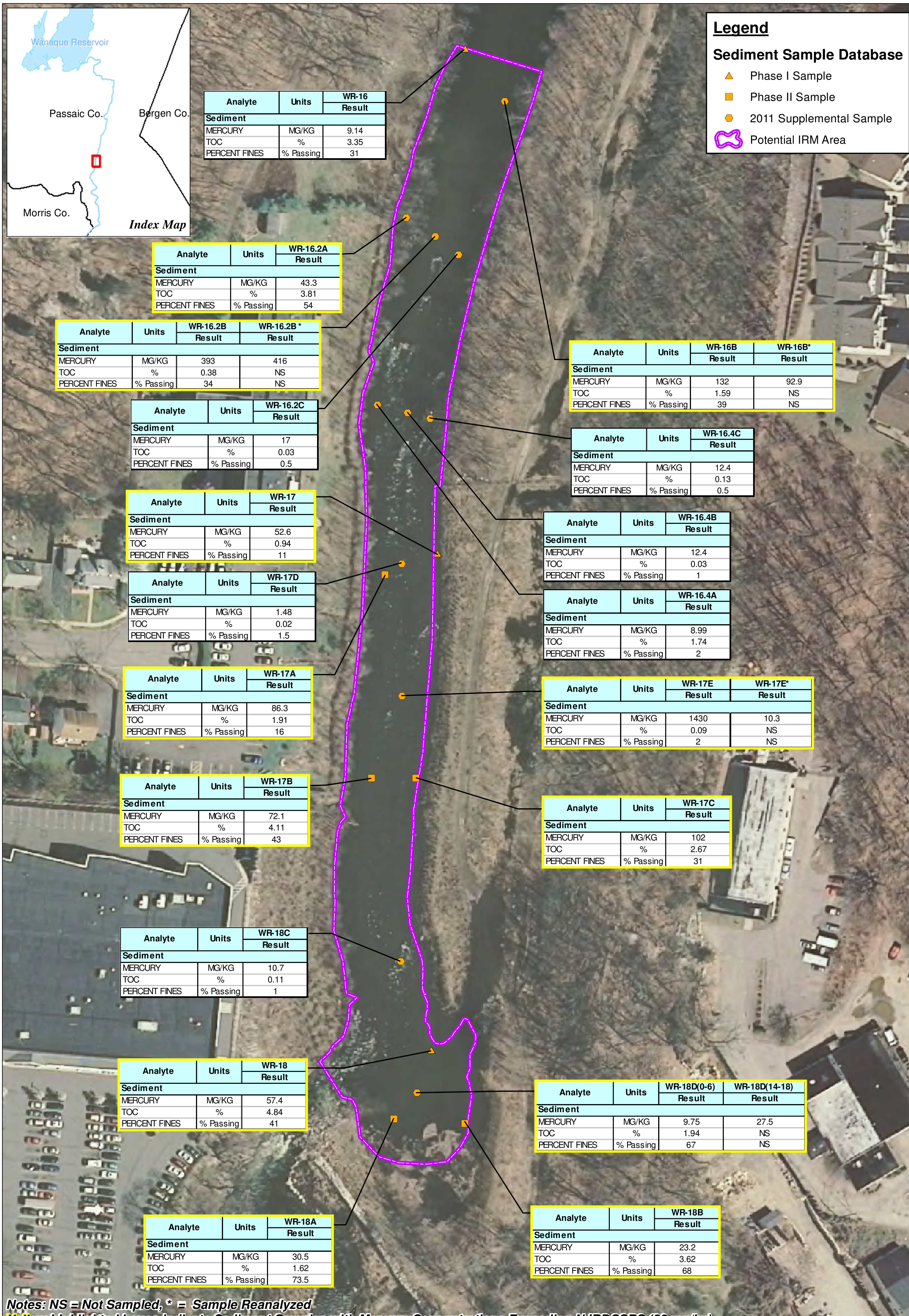


Figure 3
Focused Study Area
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey



Analyte	Units	WR-16 Result
Sediment		
MERCURY	MG/KG	9.14
TOC	%	3.35
PERCENT FINES	% Passing	31

Analyte	Units	WR-16.2A Result
Sediment		
MERCURY	MG/KG	43.3
TOC	%	3.81
PERCENT FINES	% Passing	54

Analyte	Units	WR-16.2B Result	WR-16.2B * Result
Sediment			
MERCURY	MG/KG	393	416
TOC	%	0.38	NS
PERCENT FINES	% Passing	34	NS

Analyte	Units	WR-16.2C Result
Sediment		
MERCURY	MG/KG	17
TOC	%	0.03
PERCENT FINES	% Passing	0.5

Analyte	Units	WR-16B Result	WR-16B* Result
Sediment			
MERCURY	MG/KG	132	92.9
TOC	%	1.59	NS
PERCENT FINES	% Passing	39	NS

Analyte	Units	WR-16.4C Result
Sediment		
MERCURY	MG/KG	12.4
TOC	%	0.13
PERCENT FINES	% Passing	0.5

Analyte	Units	WR-17 Result
Sediment		
MERCURY	MG/KG	52.6
TOC	%	0.94
PERCENT FINES	% Passing	11

Analyte	Units	WR-16.4B Result
Sediment		
MERCURY	MG/KG	12.4
TOC	%	0.03
PERCENT FINES	% Passing	1

Analyte	Units	WR-17D Result
Sediment		
MERCURY	MG/KG	1.48
TOC	%	0.02
PERCENT FINES	% Passing	1.5

Analyte	Units	WR-16.4A Result
Sediment		
MERCURY	MG/KG	8.99
TOC	%	1.74
PERCENT FINES	% Passing	2

Analyte	Units	WR-17A Result
Sediment		
MERCURY	MG/KG	86.3
TOC	%	1.91
PERCENT FINES	% Passing	16

Analyte	Units	WR-17E Result	WR-17E* Result
Sediment			
MERCURY	MG/KG	1430	10.3
TOC	%	0.09	NS
PERCENT FINES	% Passing	2	NS

Analyte	Units	WR-17B Result
Sediment		
MERCURY	MG/KG	72.1
TOC	%	4.11
PERCENT FINES	% Passing	43

Analyte	Units	WR-17C Result
Sediment		
MERCURY	MG/KG	102
TOC	%	2.67
PERCENT FINES	% Passing	31

Analyte	Units	WR-18C Result
Sediment		
MERCURY	MG/KG	10.7
TOC	%	0.11
PERCENT FINES	% Passing	1

Analyte	Units	WR-18 Result
Sediment		
MERCURY	MG/KG	57.4
TOC	%	4.84
PERCENT FINES	% Passing	41

Analyte	Units	WR-18D(0-6) Result	WR-18D(14-18) Result
Sediment			
MERCURY	MG/KG	9.75	27.5
TOC	%	1.94	NS
PERCENT FINES	% Passing	67	NS

Analyte	Units	WR-18B Result
Sediment		
MERCURY	MG/KG	23.2
TOC	%	3.62
PERCENT FINES	% Passing	68

Analyte	Units	WR-18A Result
Sediment		
MERCURY	MG/KG	30.5
TOC	%	1.62
PERCENT FINES	% Passing	73.5

*Notes: NS = Not Sampled, * = Sample Reanalyzed*

Yellow highlighted boxes indicate Sediment Samples with Mercury Concentrations Exceeding NJRDCSRS (23 mg/kg)

Source: Aerial Photography - NJDEP 2007

URS

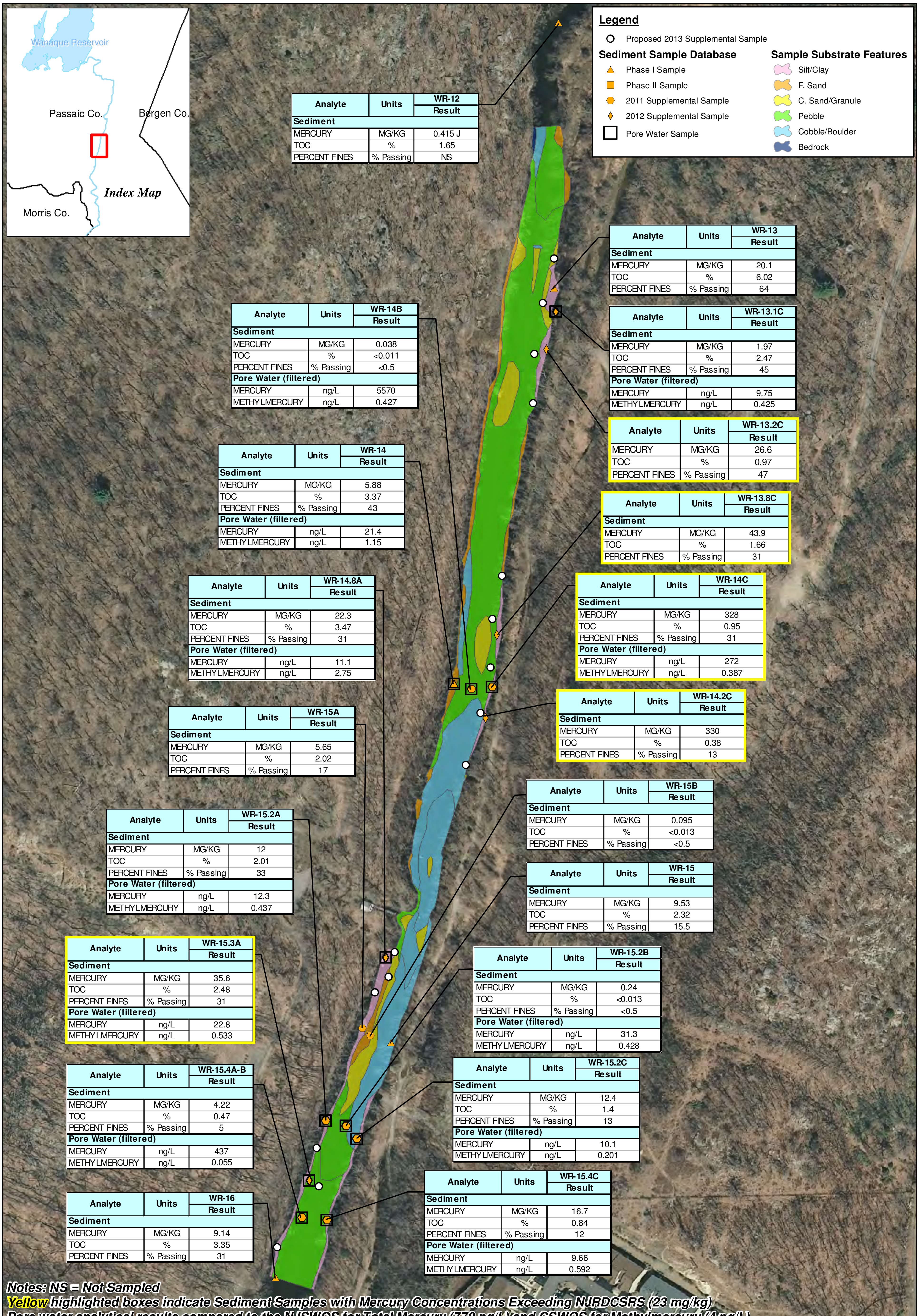
N

0 50 100 200

Feet

Figure 4
Reach 2 Sediment Sampling Stations within the Proposed IRM Area
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

Path: S:\Projects\IMS\DUPONT\PMPTNLKS\Projects\Out\OBG\DuPont PLWV IRMWP Figure 4.mxd



Analyte	Units	WR-12 Result
Sediment		
MERCURY	MG/KG	0.415 J
TOC	%	1.65
PERCENT FINES	% Passing	NS

Analyte	Units	WR-13 Result
Sediment		
MERCURY	MG/KG	20.1
TOC	%	6.02
PERCENT FINES	% Passing	64

Analyte	Units	WR-14B Result
Sediment		
MERCURY	MG/KG	0.038
TOC	%	<0.011
PERCENT FINES	% Passing	<0.5
Pore Water (filtered)		
MERCURY	ng/L	5570
METHYLMERCURY	ng/L	0.427

Analyte	Units	WR-13.1C Result
Sediment		
MERCURY	MG/KG	1.97
TOC	%	2.47
PERCENT FINES	% Passing	45
Pore Water (filtered)		
MERCURY	ng/L	9.75
METHYLMERCURY	ng/L	0.425

Analyte	Units	WR-13.2C Result
MERCURY	MG/KG	26.6
TOC	%	0.97
PERCENT FINES	% Passing	47

Analyte	Units	WR-14 Result
Sediment		
MERCURY	MG/KG	5.88
TOC	%	3.37
PERCENT FINES	% Passing	43
Pore Water (filtered)		
MERCURY	ng/L	21.4
METHYLMERCURY	ng/L	1.15

Analyte	Units	WR-13.8C Result
Sediment		
MERCURY	MG/KG	43.9
TOC	%	1.66
PERCENT FINES	% Passing	31

Analyte	Units	WR-14.8A Result
Sediment		
MERCURY	MG/KG	22.3
TOC	%	3.47
PERCENT FINES	% Passing	31
Pore Water (filtered)		
MERCURY	ng/L	11.1
METHYLMERCURY	ng/L	2.75

Analyte	Units	WR-14C Result
Sediment		
MERCURY	MG/KG	328
TOC	%	0.95
PERCENT FINES	% Passing	31
Pore Water (filtered)		
MERCURY	ng/L	272
METHYLMERCURY	ng/L	0.387

Analyte	Units	WR-15A Result
Sediment		
MERCURY	MG/KG	5.65
TOC	%	2.02
PERCENT FINES	% Passing	17

Analyte	Units	WR-14.2C Result
Sediment		
MERCURY	MG/KG	330
TOC	%	0.38
PERCENT FINES	% Passing	13

Analyte	Units	WR-15B Result
Sediment		
MERCURY	MG/KG	0.095
TOC	%	<0.013
PERCENT FINES	% Passing	<0.5

Analyte	Units	WR-15.2A Result
Sediment		
MERCURY	MG/KG	12
TOC	%	2.01
PERCENT FINES	% Passing	33
Pore Water (filtered)		
MERCURY	ng/L	12.3
METHYLMERCURY	ng/L	0.437

Analyte	Units	WR-15 Result
Sediment		
MERCURY	MG/KG	9.53
TOC	%	2.32
PERCENT FINES	% Passing	15.5

Analyte	Units	WR-15.3A Result
Sediment		
MERCURY	MG/KG	35.6
TOC	%	2.48
PERCENT FINES	% Passing	31
Pore Water (filtered)		
MERCURY	ng/L	22.8
METHYLMERCURY	ng/L	0.533

Analyte	Units	WR-15.2B Result
Sediment		
MERCURY	MG/KG	0.24
TOC	%	<0.013
PERCENT FINES	% Passing	<0.5
Pore Water (filtered)		
MERCURY	ng/L	31.3
METHYLMERCURY	ng/L	0.428

Analyte	Units	WR-15.4A-B Result
Sediment		
MERCURY	MG/KG	4.22
TOC	%	0.47
PERCENT FINES	% Passing	5
Pore Water (filtered)		
MERCURY	ng/L	437
METHYLMERCURY	ng/L	0.055

Analyte	Units	WR-15.2C Result
Sediment		
MERCURY	MG/KG	12.4
TOC	%	1.4
PERCENT FINES	% Passing	13
Pore Water (filtered)		
MERCURY	ng/L	10.1
METHYLMERCURY	ng/L	0.201

Analyte	Units	WR-16 Result
Sediment		
MERCURY	MG/KG	9.14
TOC	%	3.35
PERCENT FINES	% Passing	31

Analyte	Units	WR-15.4C Result
Sediment		
MERCURY	MG/KG	16.7
TOC	%	0.84
PERCENT FINES	% Passing	12
Pore Water (filtered)		
MERCURY	ng/L	9.66
METHYLMERCURY	ng/L	0.592

Notes: NS = Not Sampled
Yellow highlighted boxes indicate Sediment Samples with Mercury Concentrations Exceeding NJRDCSRS (23 mg/kg)
Pore water analytical results compared to the NJSWQS for Total Mercury (770 ng/L) and CSWQS for Methylmercury (4 ng/L)

Source: Aerial Photography - NJDEP 2007

N

0 100 200 400
Feet

Figure 5
Reach 2 Sediment and Pore Water Sampling Stations
Upstream of the Proposed IRM Area to WR-12
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

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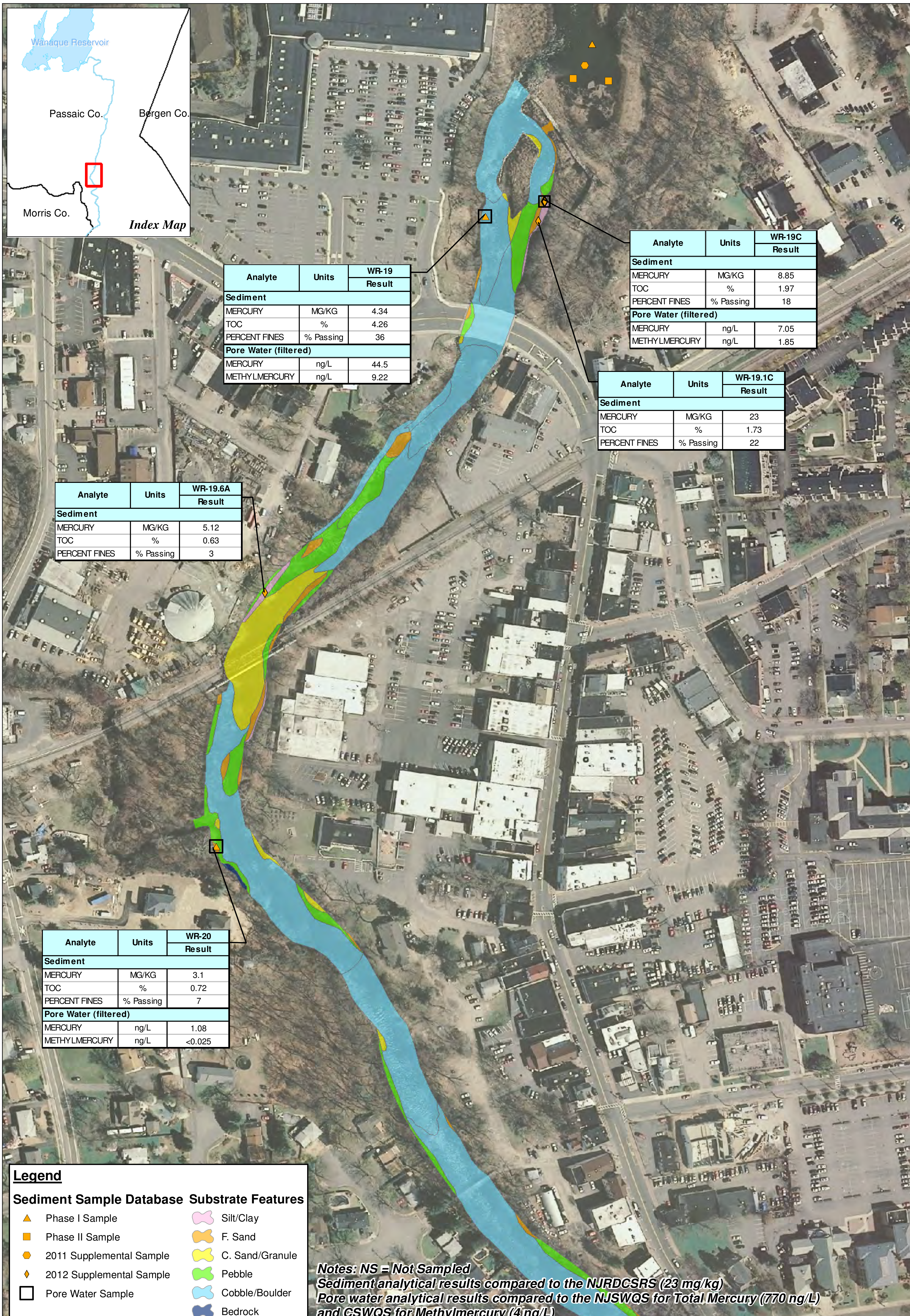


Analyte	Units	WR-19 Result
Sediment		
MERCURY	MG/KG	4.34
TOC	%	4.26
PERCENT FINES	% Passing	36
Pore Water (filtered)		
MERCURY	ng/L	44.5
METHYLMERCURY	ng/L	9.22

Analyte	Units	WR-19C Result
Sediment		
MERCURY	MG/KG	8.85
TOC	%	1.97
PERCENT FINES	% Passing	18
Pore Water (filtered)		
MERCURY	ng/L	7.05
METHYLMERCURY	ng/L	1.85

Analyte	Units	WR-19.1C Result
Sediment		
MERCURY	MG/KG	23
TOC	%	1.73
PERCENT FINES	% Passing	22

Analyte	Units	WR-19.6A Result
Sediment		
MERCURY	MG/KG	5.12
TOC	%	0.63
PERCENT FINES	% Passing	3

Analyte	Units	WR-20 Result
Sediment		
MERCURY	MG/KG	3.1
TOC	%	0.72
PERCENT FINES	% Passing	7
Pore Water (filtered)		
MERCURY	ng/L	1.08
METHYLMERCURY	ng/L	<0.025

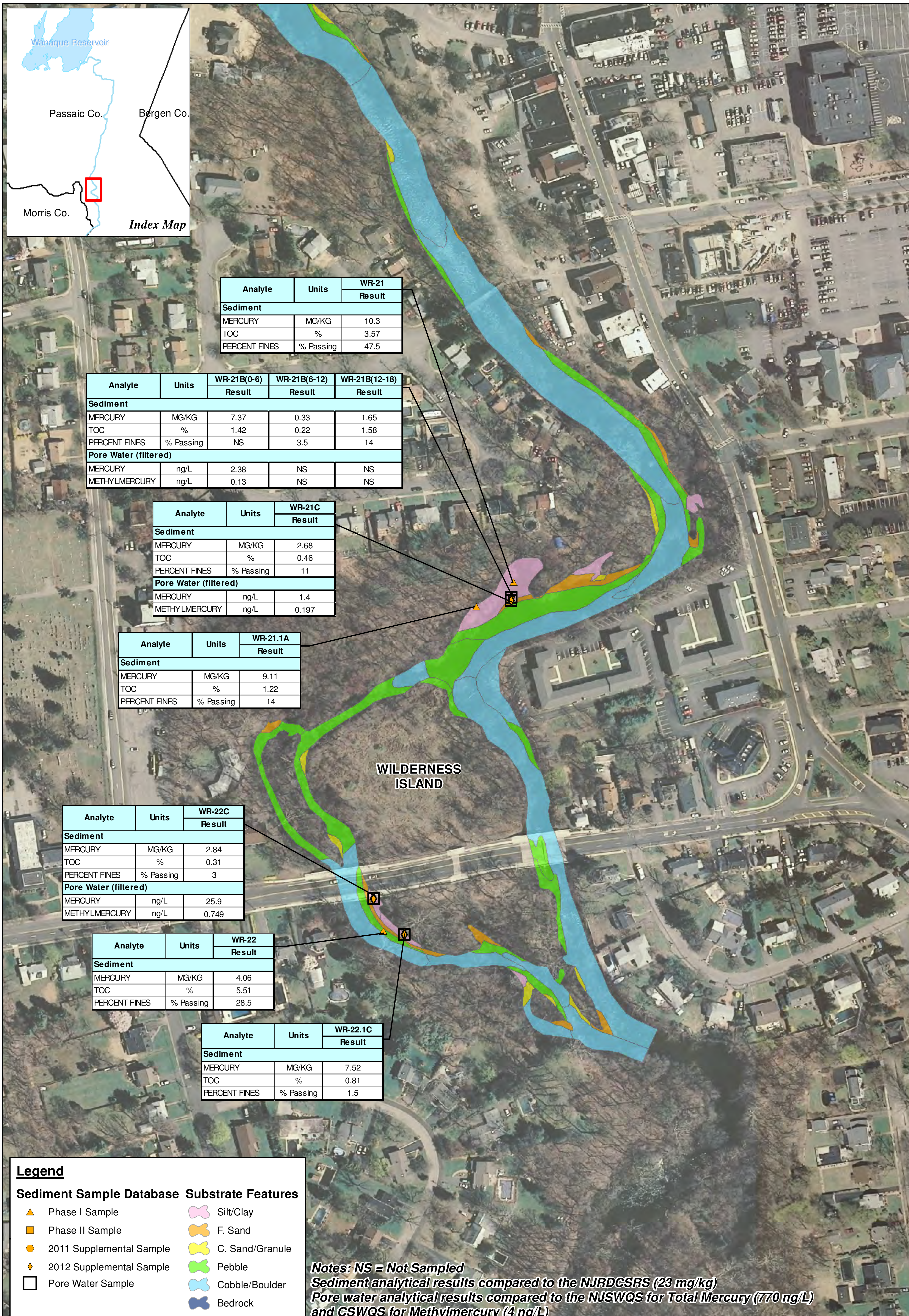
Notes: NS = Not Sampled
Sediment analytical results compared to the NJRDCSRS (23 mg/kg)
Pore water analytical results compared to the NJSWQS for Total Mercury (770 ng/L) and CSWQS for Methylmercury (4 ng/L)

Source: Aerial Photography - NJDEP 2007

N

0 100 200 400
Feet

Figure 6
Reach 3 Sediment and Pore Water Sampling Stations
Downstream of the Proposed IRM Area to WR-20
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey



Analyte	Units	WR-21 Result
Sediment		
MERCURY	MG/KG	10.3
TOC	%	3.57
PERCENT FINES	% Passing	47.5

Analyte	Units	WR-21B(0-6) Result	WR-21B(6-12) Result	WR-21B(12-18) Result
Sediment				
MERCURY	MG/KG	7.37	0.33	1.65
TOC	%	1.42	0.22	1.58
PERCENT FINES	% Passing	NS	3.5	14
Pore Water (filtered)				
MERCURY	ng/L	2.38	NS	NS
METHYLMERCURY	ng/L	0.13	NS	NS

Analyte	Units	WR-21C Result
Sediment		
MERCURY	MG/KG	2.68
TOC	%	0.46
PERCENT FINES	% Passing	11
Pore Water (filtered)		
MERCURY	ng/L	1.4
METHYLMERCURY	ng/L	0.197

Analyte	Units	WR-21.1A Result
Sediment		
MERCURY	MG/KG	9.11
TOC	%	1.22
PERCENT FINES	% Passing	14

Analyte	Units	WR-22C Result
Sediment		
MERCURY	MG/KG	2.84
TOC	%	0.31
PERCENT FINES	% Passing	3
Pore Water (filtered)		
MERCURY	ng/L	25.9
METHYLMERCURY	ng/L	0.749

Analyte	Units	WR-22 Result
Sediment		
MERCURY	MG/KG	4.06
TOC	%	5.51
PERCENT FINES	% Passing	28.5

Analyte	Units	WR-22.1C Result
Sediment		
MERCURY	MG/KG	7.52
TOC	%	0.81
PERCENT FINES	% Passing	1.5

Notes: NS = Not Sampled
Sediment analytical results compared to the NJRDCSRS (23 mg/kg)
Pore water analytical results compared to the NJSWQS for Total Mercury (770 ng/L) and CSWQS for Methylmercury (4 ng/L)

Source: Aerial Photography - NJDEP 2007

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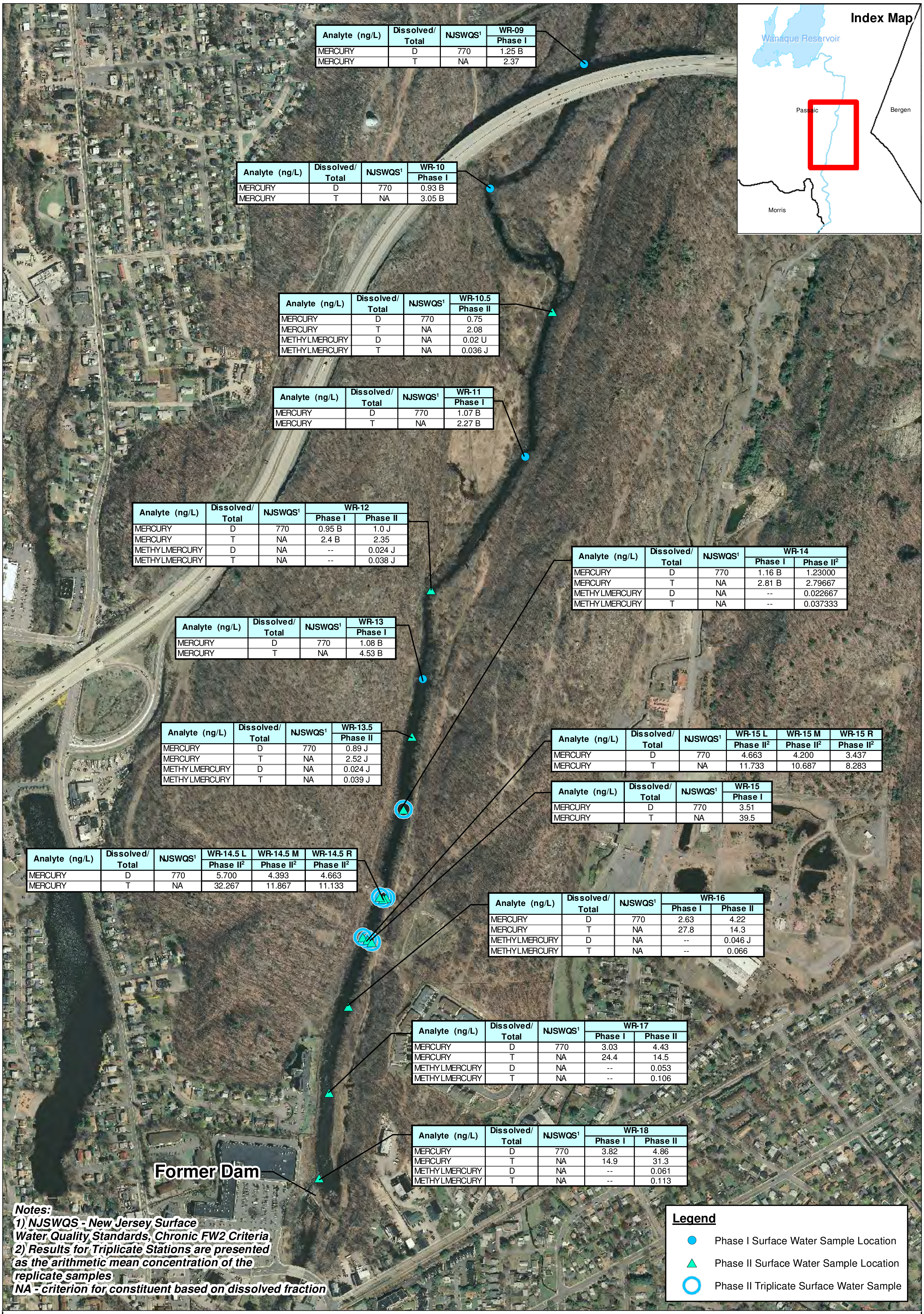
Figure 7
Reach 3 Sediment and Pore Water Sampling Stations from WR-20 to WR-22
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey



Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-09
			Phase I
MERCURY	D	770	1.25 B
MERCURY	T	NA	2.37

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-10
			Phase I
MERCURY	D	770	0.93 B
MERCURY	T	NA	3.05 B

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-10.5
			Phase II
MERCURY	D	770	0.75
MERCURY	T	NA	2.08
METHYLMERCURY	D	NA	0.02 U
METHYLMERCURY	T	NA	0.036 J

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-11
			Phase I
MERCURY	D	770	1.07 B
MERCURY	T	NA	2.27 B

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-12	
			Phase I	Phase II
MERCURY	D	770	0.95 B	1.0 J
MERCURY	T	NA	2.4 B	2.35
METHYLMERCURY	D	NA	--	0.024 J
METHYLMERCURY	T	NA	--	0.038 J

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-14	
			Phase I	Phase II[2]
MERCURY	D	770	1.16 B	1.23000
MERCURY	T	NA	2.81 B	2.79667
METHYLMERCURY	D	NA	--	0.022667
METHYLMERCURY	T	NA	--	0.037333

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-13
			Phase I
MERCURY	D	770	1.08 B
MERCURY	T	NA	4.53 B

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-13.5
			Phase II
MERCURY	D	770	0.89 J
MERCURY	T	NA	2.52 J
METHYLMERCURY	D	NA	0.024 J
METHYLMERCURY	T	NA	0.039 J

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-15 L	WR-15 M	WR-15 R
			Phase II[2]	Phase II[2]	Phase II[2]
MERCURY	D	770	4.663	4.200	3.437
MERCURY	T	NA	11.733	10.687	8.283

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-15
			Phase I
MERCURY	D	770	3.51
MERCURY	T	NA	39.5

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-14.5 L	WR-14.5 M	WR-14.5 R
			Phase II[2]	Phase II[2]	Phase II[2]
MERCURY	D	770	5.700	4.393	4.663
MERCURY	T	NA	32.267	11.867	11.133

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-16	
			Phase I	Phase II
MERCURY	D	770	2.63	4.22
MERCURY	T	NA	27.8	14.3
METHYLMERCURY	D	NA	--	0.046 J
METHYLMERCURY	T	NA	--	0.066

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-17	
			Phase I	Phase II
MERCURY	D	770	3.03	4.43
MERCURY	T	NA	24.4	14.5
METHYLMERCURY	D	NA	--	0.053
METHYLMERCURY	T	NA	--	0.106

Analyte (ng/L)	Dissolved/ Total	NJSWQS[1]	WR-18	
			Phase I	Phase II
MERCURY	D	770	3.82	4.86
MERCURY	T	NA	14.9	31.3
METHYLMERCURY	D	NA	--	0.061
METHYLMERCURY	T	NA	--	0.113

Notes:
1) NJSWQS - New Jersey Surface Water Quality Standards, Chronic FW2 Criteria
2) Results for Triplicate Stations are presented as the arithmetic mean concentration of the replicate samples
NA - criterion for constituent based on dissolved fraction

Source: Aerial Photography - NJDEP 2007

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0 250 500 1,000 Feet

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Figure 8
Detected Constituents in Surface Water- Reach 2 Wanaque River
Wanaque River Investigation
Interim Remedial Measure Work Plan
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey